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ABSTRACT

Professional educators must take advantage of public awareness and demand for change if education is to avoid a decade "full of sound and fury" in the 1980s. A solid statistical base is needed from which to describe, select, test, and evaluate policy alternatives. Teachers and government are critical inputs into the educational system. Teachers play the central role in the education enterprise, and it follows that data about teachers rank among the most important sets of information needed for making decisions about reforms in policy and practice. Federal government is the single largest source of support available for research and development, and policy setters need a simplified and readily available summary of the areas of education receiving federal investments, along with comparative data on how those investments have changed over time. The five aspects of schooling process mentioned are: textbooks, allocation of instructional time, utilization of resources from business and industry, the use of computers, and out-of-school opportunities for learning. A set of indicators for collecting data on outputs should be: (1) linked to inputs and processes; (2) indicative of permanent and significant change in the learner; and (3) of sufficient social significance to merit direct application to decisions about policy and practice. (JAZ)

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EDUCATIONAL STATISTICS AND INSTRUCTIONAL REFORM:

VITAL LINKS TO POLICY AND PRACTICE

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Like the month of March, education in the 1980s came in roaring like a lion. Teachers and administrators braced themselves against the storm of report after report prepared by commission after commission--all recommending major, minor, and sometimes conflicting changes in how schools are conceived, structured, and evaluated. If education in the 1980s continues to behave like the winds of March, the decade may well end with all the gentleness of a lamb. The storm and fury of shouts for reform will have dissipated, leaving behind little more than a whisper of a lingering, gentle breeze.

If education is to avoid a decade "full of sound and fury, signifying nothing," professional educators must take advantage of the early storm of public awareness and demand for change, while at the same time assuring that new directions in policy and procedure are based more on fact than fantasy, more on prudence than politics. That is a tall order given the complex matrix of interactive elements that define the educational enterprise. It is a taller order still when the logical link between inputs, processes and outcomes remains in many instances obscure. Nevertheless, if we are to emerge from this decade with a better edcuational system than we had when we

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started, we will need more than commission reports and heated discussions. We will need a solid statistical base from which policy alternatives can be described, selected, tested, and evaluated.

INPUTS. Education in every decade is characterized by its jargon, and no less so in the 1980s. Among the slogans of the day are "equity" and "excellence," concepts seen by some as competitors for limited financial resources and by others as complementary components of a unifying vision for education. Whichever stance one may take, there is little disagreement that the search for policies and practices that promote either or both of these ends is a worthwhile mission. Whatever measure of equity and excellence may actually be attained will be influenced by numerous factors, many of which constitute critical inputs into the system. In this section, I will discuss two inputs: teachers and government.

Teachers. The research on effective schools demonstrates the importance of the principal as instructional leader. The best schools enjoy a working environment in which the principal, by word and deed, provides oportunities for excellence and equity and promotes their achievement. But where does that achievement occur? Not in the principal's office, not in inservice training, not even at school board meetings. Achievement occurs in the classroom. Not discounting the importance of good leadership, it is, when all is said and done, the classroom teacher who plays the central role in the

educational enterprise. Teachers speak again and again about what they do when they "close the classroom door" and have the students to themselves. Teachers themselves are the first to acknowledge that the rhetoric of professional convention, staff development seminar, and faculty lounge may go by the board when the central instructional decision of what to do fifth period next Tuesday is made by the teacher--and, in most cases, that teacher alone. Whatever we may understand about the educational environment, processes or outcomes is meaningless unless we know what is happening in the basic instructional unit: the day-to-day interchange between teacher and student.

If this premise is correct, then it follows that the most important decisions about policy and practice concern teachers themselves. It also follows that data about teachers rank among the most important sets of information needed for making decisions about reforms in policy and practice. Thus, if the data base currently provided by the National Center for Eduation Statistics is to be strengthened in the most meaningful ways, it makes sense to collect and disseminate data on teachers.

The data base already contains some information on teachers, but more is needed. First, policy makers need to know how many teachers teach what subjects--a statistic that is fundamentally important and very difficult to obtain in sufficient detail. (For example, lumping all sciences together fails to differentiate needs in biology from needs in physics.) In addition, local, state, and national policy makers need to

know how well prepared teachers are to handle the subjects they teach. What does certification in a given subject area actually mean in the fifty states, and how well do those areas of certification actually correlate with teaching assignments and teachers' perceptions of their own personal competence? Teachers complain of being asked to teach subjects they feel ill-prepared to present. Professional organizations lament the assignment of inadequately qualified personnel to demanding positions--for example, the teaching of chemistry and computer science. Administrators report difficulties in locating physics teachers, while at the same time turning away applicants for elementary school jobs. While such complaints are frequently heard, there is little hard data available to either support or refute such contentions--much less to illuminate the source of the problem or the avenues toward its solution.

Beyond that, decision makers need to know what teachers perceive as the burdens and barriers hindering their performance. What are the elements of teaching that made it a satisfying or unsatisfying profession? Are salaries and schedules major issues in the minds of teachers? Is community support (or the lack of it) a major factor? What about respect and prestige in the community? Do teachers perceive themselves as playing a significant role in the decision-making processes of the school or district, or do they see themselves as pawns in some higher-order, three-dimensional chess game? Why are so few young teachers now entering the profession? What is the relationship, if any, between teachers' judgments of summer

institutes, inservice training, and staff development programs and their on-the-job performance in the classroom? Data are needed on the subject matter preparation of elementary school teachers, where failure to teach such subjects as science and social studies may be related to inadequacies in preservice preparation. Since membership in a professional society may be one indicator of professionalism among teachers, the number and percent of teachers reporting membership in a profesional society (cross-checked against the rolls of the professional societies themselves) should prove enlightening. It is also important to know what percentage of teachers have access to--and avail themselves of--opportunities for professional growth including sabbatical leaves, graduate school work, internships, fellowships, school-industry cooperative programs and so on.

While it is true that teaching typically fails to attract those college students who attain the highest scores on standardized tests, and while it is also true that teachers' salaries tend to be lower than those paid to professionals in many other fields, teaching conditions may be factors that are as great--or perhaps even greater--determinants of teacher satisfaction and of the attractiveness of the profession to those newly entering the work force. There is reason to suspect the national averages on class size (1). Fresh insights may emerge from analysis of class size data according to urban and rural settings, as class sizes appear to be generally larger in metropolitan than in rural settings. Data are also needed to

answer the question of teaching and preparation load--a complaint frequently heard from secondary school teachers. How many classes a day of how many students are teachers required to conduct? How much preparation time does the schedule allow? How many different preparations are required? How many extracuricular activities do teachers sponsor? How much time do those require? What administrative duties must teachers perform and how much time must they devote to them? How many teachers are responsible for the implementation of some part of an IEP for how many students in a mainstreaming setting? How well-prepared do teachers consider themselves to be for their mainstreaming assignments? What do teachers consider their most productive and least productive duties? It may well turn out that the key to improving instruction is improving the working conditions of teachers.

A related concern is that of resources. What resources do teachers have available to help them do their jobs better? Such resources may be either human or material, ranging from the services of subject matter coordinators or supervisors operating at the district level to laboratory equipment and supplies for daily classroom use. I know teachers who work in schools that lack any sort of duplicating equipment--not even a mimeograph, much less a photocopier. At one school I visited recently, there was no money available to purchase construction paper for children's art projects! Statistics are needed to show how school budgets are spent. Some extant tables of data lump expenditures into general categories such as "administration" or

"capital equipment." But more specific information is needed. For example, how much can the average science teacher expect to spend on materials and supplies? How much is available for field trips? Are dollars expended for instructional aides assigned to teachers in specific subject matter fields or at specific grade levels? If so, how much? How much money is spent on textbooks and how often are textbooks replaced? Are dollars allocated to textbooks in lieu of other (possibly more effective) instructional materials such as audiovisual materials, computer software, and primary source reading materials? How many dollars are available to pay substitute teachers so that contract teachers may be released to attend professional meetings and engage in other professional learning experiences? Is the capital equipment acquisition likely to be computers for the administrative offices or computer labs for student use? What proportion of administrative salaries goes to those who provide instructional services to classroom teachers and students, as opposed to those engaged in record-keeping, accounting, purchasing, facilities maintenance, and other services? Finally, how much time and money is devoted to involving teachers in the processes of policy decision making? How frequently are teachers given release time to participate in curriculum committees, plan staff development programs, or share their expertise with other teachers?

The question of teacher shortage deserves special mention. As the GAO report noted (2), the data were not available to conclude whether the nation was truly experiencing

a shortage of math and science teachers. Certainly, such a situation needs to be avoided in the future. One help may be to look at rural and urban data separately. In Colorado, for example, the shortage appears to affect the rural areas only. In the densely populated, well-funded school districts, every available job enjoys many hundreds of applicants. Not so in the rural areas where replacing a physics teacher can prove an impossible task. Whether this difficulty exists nationwide or is as widespread in other states as it seems to be in Colorado demands statistical verification. But, if it turns out that the problem is not numbers but distribution, policy makers may want to consider such promising solutions as incentive plans for attracting teachers to rural schools, instrutional programs shared among rural schools via technology, traveling "scholars in residence" programs, and summer enrichment options for rural students.

Data on teachers and the resources available to teachers are of more than idle interest. The supply of new teacher graduates has been declining over the last fifteen years (3), even though, during that period, teachers' salaries rose (4). To what extent that rise reflects either a real change in starting salaries or an aging teaching population advancing through the salary scales is uncertain. But on the face of things it appears that salary is not the only issue of concern. If teachers are to improve, if the best of young people are to be attracted into teaching, and if the improved quality of teaching is to lead to improved instructional outcomes for

students, it is imperative that choices about policy and practice be made now that will promote improvements before the end of this decade. At the present time, there appears to be little being done to improve the conditions under which teachers labor--career ladders and merit pay notwithstanding. Collecting the relevant data will not ensure reform, but it will provide the foundation upon which reform can be built.

Government. Another important input factor affecting reform of policy and practice is the federal investment in research and development. While federal dollars foot only a minor portion of our nation's bill for education, the federal government is the single largest source of support available for research, development, trial of innovations, and dissemination of model practices. The federal government's role remains critical in the creation of new knowledge and in the application of that knowledge to the preparation and testing of new instructional materials, training regimens and evaluative standards and norms. The investment of the federal government in research and development is the major stimulus for change inserted into state and locally run systems well-known and much criticized for their inertia and traditionalism. It is sad but true, for example, that the science textbooks of the Eighties would probably look much like those of the Fifties (perhaps more encyclopedic) if it had not been for the significant investment in science curricula made by the National Science Foundation between 1957 and 1981. It is equally sad but true that momentum for environmental education was lost when the Office of

Environmental Education (U. S. O. E.) was shut down and the Environmental Education Act for all practical purposes abandoned.

My reason for citing these examples is to point out the need that state and local policy makers have for information on federal initiatives--past, present and future. It is virtually impossible for anyone not intimately connected with federal funding to keep track of all the programs planned, operational, or declining within the federal budget. Nor is it always possible to discern the funding trends developing within any single agency or program. Thus, policy setters need a simplified and readily available summary of the areas of education receiving federal investments, along with some comparative data on how those investments have changed over time. Also of value would be some analysis of trends to be inferred from these data, even if the trend analysis were forced to rely on little more than expert opinion.

PROCESSES. While it is useful to visualize schooling as a complex systems diagram characterized by a series of interlocking inputs, processes, and outcomes, that view tends to obscure the fundamental "humanness" of teaching and learning. Students do not drop out of school because of teacher shortages or trends in government-supported research. Surprisingly few leave because they are failing. Instead, they leave because school is boring, the curriculum irrelevant, relationships with teachers contentious (5). Schooling is a day-to-day chore for

many students and, regrettably, for many of their teachers as well. The events that occur seven hours a day, 180 days a year for 40 million students and two million teachers are the heart of the educational enterprise. Much of what goes on in schools is so complex, varied, and idiosyncratic as to defy nationwide efforts at data-gathering. Yet to ignore the importance of the process of schooling when collecting statistics is to cripple policy makers who must create policy and improve practice. Only five aspects of the process of schooling are mentioned in this section, though many others are of equal, and perhaps greater, importance. This section briefly explores textbooks, allocations of instructional time, the utilization of resources from local business and industry, the use of computers, and out-of-school opportunities for learning.

Textbooks. Numerous reports have described the domination of the curriculum by the textbook (5, 6, 7), usually suggesting that such domination is less than desirable. Some probing into the phenomenon of textbook domination is sorely needed, if only to illuminate the relationship between curriculum content and other dysfunctional aspects of schooling. What budgetary trade-offs are districts making when purchasing a text for every child? How rigid are districts' regulations concerning what is to be "covered" in a particular class? How consistent are such regulations from state to state and district to district? And how closely are those regulations aligned with the standard content of traditional textbooks? Are teachers

bound to the textbook because of lack of preparation time, lack of training in designing lessons, or lack of incentive or motivation to go beyond the textbook in structuring course content?

Also of concern is the sameness of textbooks from different sources and the apparent unwillingness of textbook publishers to offer books that stray too far from the traditional. For example, many of our nation's largest publishers have declined invitations to publish instructional materials designed for interdisciplinary courses. Curriculum writers argue that the market for such materials should be adequate, since courses offered under titles ranging from "Contemporary Problems" to "Environmental Studies" to "Science, Technology, and Society" are far from rare. Publishers counter that only "basal" texts for discrete disciplinary fields such as biology, chemistry and physics offer markets sufficiently large to prove profitable. For this reason, many good innovative curricular units--some developed under federal grants--have been kept off the mass market. Yet neither the publishing industry nor the curriculum writers possess the hard data needed to settle the argument. Here again, one encounters the problem of trends over time. Are the number and scope of "electives" and "quarter courses" declining as some have argued or remaining stable under a new set of course titles and/or descriptions? Alternatively, are mainstream disciplinary courses being redefined to include greater integration of knowledge, as some have argued they should? A carefully structured survey may be

able to answer these questions, and the results may dramatically affect the kinds of educational materials that fall into the hands of teachers and students in the years ahead.

Instructional Time. A factor related to textbook domination is the allocation of instructional time. Specialists in curriculum and instruction lament the amount of class time students spend listening to lectures, memorizing, and regurgitating trivial information; yet it is the rare teacher who will admit to such a style. If policy makers are to ameliorate this situation--which indeed exists whether teachers deny it or not (9, 10)--data are needed on how class time is actually spent and what kinds of learning environments are actually created. There is a difference in the level of active involvement students can achieve in an open-ended laboratory as compared with a teacher demonstration. Small-group instruction is more involving than working alone if properly structured. Discussions that show some connection to real-life experience are more engaging than those that explain theory in isolation from objective experience. Collection of data on classroom practices is difficult because of definitional and perceptual variation, but nevertheless critical if the process of schooling is to to be improved.

Related to the use of instructional time is the question of the prevalence of nontraditional patterns of scheduling and credit-giving. It would be helpful to know, for example, how many schools use modular scheduling and how that number has changed over recent years. How many schools permit an open

campus for secondary students and, once again, how has that pattern changed over the years? The instructional decision-making process would be enhanced if policy makers had some idea how many schools give credit for community service or work experience, how many allow or encourage independent study, how many provide mentorships or independent learning opportunities for interested or talented students, and so forth. Also of considerable import are the evaluation mechanisms used. Are any schools using alternative grading and reporting systems differing from the traditional A-F or number system? If so, what are those alternatives and how successful have they been? Data such as these may be more descriptive than empirical, but nevertheless useful to the decision making process.

Business and Industry. Also of mounting importance in the 1980s is the involvement of business and industry in schools. So widespread are "adopt-a-school programs," school-industry partnerships, and collaborative action groups like the Alliances for Science that serve Minnesota and Colorado (11) that the melding of the interests of industry and schools can be called no less than the grand, national experiment of the Eighties. What will come of all the attempts at partnership remains to be seen. Thus, the time is right to begin collecting data on what may emerge as an important trend in education over the next ten to fifteen years. The National Center for Education Statistics should attempt to gather and disseminate data on the number and nature of school-industry partnerships operating nationwide (Some of that data is already available

through the White House Office on Private Sector Initiatives.) The Center should also consider collecting data on the extent to which such resources actually utilized? What do teachers and school administrators see as the advantages and disadvantages of a partnerhsip with a local business or industry? And what are the stumbling blocks that impede effective collaboration? Finally, to what degree are the resources of business and industry actually brought to students through such programs?

Computers. Another trend that may be approaching a turning point is the use of computers in schools. Current evidence indicates that the computer movement may be slowing as a result of too few computers and too little teacher inservice training (12). Whatever the fate of computers over the next decade may turn out to be, it will be important to document the phenomenon--as either success or failure of the "computer revolution" will inform future decision makers as to the likely fate of technological innovations introduced into traditional patterns of schooling via the commercial marketplace. Thus, it will be important to continue to collect data on the numbers of computers available in the nation's schools. Those data need to be broken down in terms of the size of the student population served in rural and urban schools. It will also be essential to continue to track the preferred use of computers--whether for general computer literacy or as a tool for enriching learning in standard subject matter areas. In addition, data should be collected on the nature and length of training provided to teachers, the cost and availability of repair and maintenance

services, and the investments made in software.

Out-of-School Learning. A final process element that requires additional data collection is the learning that occurs in non-school settings. It has been suggested, for example, that schools rank behind home and community activities as a child's primary source of information about science (13). That situation may be either desirable or deplorable, depending upon one's value stance regarding the relative role that schools should play in the shaping of youth. Nonetheless, recognizing schools as only one among several resources available for education allows policy makers to assess a wider and richer range of alternatives when planning comprehensive instructional programs. Museums, planetariums, zoos, botanical gardens, public libraries, television, radio, motion pictures and locally sponsored workshops in the arts and humanities can and do play a significant role in the processes of education--as do community service and special interest groups such as the Girl Scouts and the Audobon Society. Those who plan policy and influence practice need information on the kinds of community and media-based options that are available and the extent to which school and out-of-school programs can be complementary and mutually reinforcing.

OUTPUTS. Of the three areas considered here--inputs, processes, and outputs--outputs most often command the lion's share of attention. Output measures are also most often subject

to misinterpretation, sensationalism, and abuse. As a society, we approach education with a free enterprise mentality. There must be a "product." Furthermore, that product must yield a "bottom line" that shows a sizable "profit." In our attempt to meet the demands of the marketplace mentality applied to teaching and learning, we tend to overlook the variability among human beings that makes it difficult, if not impossible, to determine how individual students have been changed in some desirable way as a result of highly variable instructional experiences conducted over a long period of time. To counter that misperception, we must remind ourselves that education always has been and always will be fundamentally an article of faith. As an enlightened society, we have no choice but to continue with the assumption that quality instruction increases the likelihood (but does not guarantee) that young people will leave their formal schooling with some knowledge, skills and values that bear intrinsic, if immeasurable, value.

The problem of outputs is, of course, plagued by the difficulty of identifying and agreeing upon a set of indicators that is (a) logically linked to inputs and processes and (2) indicative of some permanent and significant change in the learner and (3) of sufficient social significance to merit direct application to decisions about policy and practice. SAT and ACT scores, especially when compared state by state, fail to meet these criteria. These tests are designed to measure aptitude which, by definition, is resistant to experiential or instructional variables. Neither test is criterion-referenced

to the instruction that students have actually receive. Nor, to my knowledge, has any researcher been able to demonstrate a causal link between some variable present in the schooling experience and a resultant shift in ACT or SAT scores. Finally, these tests are usually taken only by those students planning college entrance, a relatively small proportion of the total student population. So, while SAT and ACT scores may assist us in determining the characteristics of the populaton of students who are college-bound, they have no utility for making decisions about instruction, nor are they of any value is evaluating the options for policy and practice that are available for meeting the needs of the majority of the elementary and secondary school population. State-by-state comparisons are misleadig at best, for they sugest a link between quality schooling and test performance that simply does not exist. In all likelihood, they reflect little more than the threat to validity called <u>selection</u> (14). Test scores correlate with the family's socioeconomic status and the level of education achieved by parents--a set of variables not randomly distributed across the fifty states. The general public should not be duped into believing that the comparisons describe any sort of real difference in the effectiveness of schools.

Of far greater utility are outcome measures that undergird assessment of who goes to school, who stays there, and why. One study that probed the reasons why GED candidates left school in the first place found irrelevance of curriculum and poor relations with teachers to be major causes. Poor academic

performance was seldom the deciding factor (5). Coupling these findings with data on minority students suggests that culturally-sensitive curricular innovations and personal relations training for teachers may be among the most promising avenues for school improvement. Of course, national data need to be collected and analyzed to determine if this hypothesis merits any further investigation.

Finally, data are needed on employer satisfaction with the entry-level job skills of their employees. It has been asserted that employers must train or retrain their employees the moment workers are hired (15). Whether there is any truth in that allegation must be determined from data on employers' expectations and level of satisfaction. It is generally believed that employers desire higher levels of skill in communciation and teamwork than either high school graduates or college graduates seem able to muster. What other skills do employers deem important? What techniques can schools borrow from industry-based training programs to better prepare students for the world of work? What do students who have newly entered the work force perceive as deficiencies in their schooling? What rewards do students derive from experiences with literature, arts, humanities and the sciences that, while only indirectly related to work performance, may nevertheless enhance the quality of life they can expect to enjoy?

COORDINATION WITH OTHER DATA COLLECTION ACTIVITIES. Through its Office of Studies and Program Assessment, the National

Science Foundation is currently supporting an update of the 1978 studies of the status of science educaton in the U. S. (7) and a cooperative endeavor with the Educational Testing Service to define and establish measures for higher order thinking skills. NAEP continues to update and expand its efforts, as do other agencies federal, state, and local. The problem is that there seldom appears to be much articulation among these efforts. Ferreting out the necessary educational statistics can be a time-consuming and frustrating task for the busy administrator, program director, legislator, or educational policy maker. It is no wonder, then, that so many fail to consult the relevant data prior to making policy decisions that may affect thousands of teachers and millions of students--for better or for worse.

In recognition of this problem, the National Center for Education Statistics should publish annually or semi-annually comprehensive summaries of statistics, data, information, and trend analyses collected from as many sources as possible. This summary should place in a single volume the best and most useful findings generated by studies conducted nationwide. The task of compiling such a compendium will be monumental. But until such time as some articulation and coordination are achieved, all important decisions about policy and practice will continue to be made without the benefit of complete and accurate data.

CONCLUSION. "Many myths are created by personal observation not disciplined by measurement" (16). Too often these myths result in ill-planned policies and ineffective practices instituted in

the nation's 16,000 school districts each year. The U. S. Constitution makes education a state and local matter, placing decisions about the quantity and quality of schooling close to the site where the schooling actually occurs. But needs for information transcend state boundaries and trends in education rapidly outdistance their local origins. The ultimate value of educational statistics rests in the application of information to local decisions. Complete and accurate data can help inform the judgment of school boards, parents, school administrators, teachers, legislators and political leaders. Data carefully collected and effectively disseminated can, in the final analysis, promote the pursuit of excellence and equity that are fundamental to the educational enterprise.

LITERATURE CITED

1. Cooke, C.; Ginsburg, A., and Smith, M. 1985. The sorry state of education statistics. (Mimeo.)

2. Program Evaluation and Methodology Division. 1984. New directions for federal programs to aid mathematics and science teaching. Washington, D. C.: U. S. General Accounting Office.

3. U. S. Department of Education. 1985. Indicators of education status and trends. (Mimeo draft.) p. 28.

4. Grant, W. V. and Snyder, T. D. Digest of education statistics 1983-84. Washington, D. C.: U. S. Government Printing Office, p. 55.

5. BUENO Center for Multicultural Education. University of Colorado-Boulder. A study on drop-outs conducted for the Office of Bilingual Education. U. S. Department of Education. Unpublished report.

6. Crosswhite, F. J.; Dossey, J. A.; Swafford, J. O; McKnight, C. C.; and Cooney, T. J. 1985. Second international mathematics study: Summary for the U. S. Washington, D. C.: National Center for Education Statistics, p. 14.

7. Weiss, I. R. 1978. Report of the 1977 national survey of science, mathematics, and social studies education. Washington, D. C.: U. S. Government Printing Office.

8. Hurd, P. DeH.; Bybee, R. W.; Kahle, J. B.; and Yager, R. E. 1980. Biology education in the secondary schools of the United States. The American Biology Teacher 45(2): 27-30+.

9. Sizer, Theodore R. 1984. Horace's compromise: The dilemma of the American high school. Boston: Houghton Mifflin Co.

10. Stake, R. E., Easley, J. et al. 1978. Case studies in science education. Volume II. Design, overview and general findings. Washington, D. C.: U. S. Government Printing Office.

11. Kennedy, M. and Valetta, V. Building alliances for science. 1985 Yearbook of the National Science Teachers Association. (In Press.)

12. Association for Supervision and Curriculum Development. 1985. Computer integration into instruction is stuck: Experts blame unclear optimal uses and three implementation problems. ASCD Update 27(5): 1+.

13. Voelker, A. M. 1982. The development of an attentive public for science: Implications for science teaching. In Yager, R. E. (Ed.). What research says to the science teacher.

Volume 4. Washington, D. C.: National Science Teachers Association. pp. 65-79.

14. Campbell, D. T. and Stanley, J. C. 1963. Experimental and quasi-experimental designs for research. Chicago: Rand McNally.

15. Multilevel Studies Branch. Division of Longitudinal and Multilevel Studies. 1985. NCES program on international education statistics. (Mimeo.) p. 4.

16. Suter, Larry. 1985. Report of the task force on international education statistics. (Mimeo). p. 3.

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